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14. ABSTRACT Our long-term scientific goals are to understand the dynamics and identify mechanisms of small-scale processes??i.e., internal tides, inertial waves, nonlinear internal waves (NLIWs), and turbulence mixing??in the ocean and thereby help develop improved parameterizations of mixing for ocean models. Mixing within the stratified ocean is a particular focus as the complex interplay of internal waves from a variety of sources and turbulence makes this a current locus of uncertainty. For this study, our focus is on generation, propagation, evolution, and dissipation of small-scale internal waves and internal tides as the Kuroshio and barotropic tides interact with the two prominent submarine ridges in Luzon Strait.					
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Generation and Evolution of Internal Waves in Luzon Strait

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LONG-TERM GOALS

Our long-term scientific goals are to understand the dynamics and identify mechanisms of small-scale processes—i.e., internal tides, inertial waves, nonlinear internal waves (NLIWs), and turbulence mixing—in the ocean and thereby help develop improved parameterizations of mixing for ocean models. Mixing within the stratified ocean is a particular focus as the complex interplay of internal waves from a variety of sources and turbulence makes this a current locus of uncertainty. For this study, our focus is on generation, propagation, evolution, and dissipation of small-scale internal waves and internal tides as the Kuroshio and barotropic tides interact with the two prominent submarine ridges in Luzon Strait.

OBJECTIVES

The primary objectives of this observational program are to quantify (1) the generation of NLIWs and internal tides in the vicinity of Luzon Strait, (2) the energy flux of NLIWs and internal tides into the Pacific Ocean and South China Sea (SCS), (3) the effects of the Kuroshio on the generation and propagation of NLIWs and internal tides, (4) the seasonal variation of NLIWs and internal tides, and (5) to study other small-scale processes, e.g., hydraulics, instabilities along internal tidal beams and at the Kuroshio front.

APPROACH

Near-field: In the vicinity of the Luzon Strait, observations will be taken using the combined 800-m-long towed CTD chain equipped with 100 CTD sensors and R/V Revelle's Doppler Sonar. These instruments are capable of taking high-frequency, $\Delta t < 1$ min, and high vertical resolution, $\Delta z = 5\text{--}10$ m, measurements of CTD and oceanic velocity from near surface to ~600-m depth.

Far-field: Full water-column velocity and temperature observations will be taken using two subsurface moorings with a near-bottom upward-looking 75-kHz ADCP and a series of SBE sensors at a sampling rate of $\Delta t = 1$ min, capable of measuring internal tides and NLIWs, on the continental slope east of Dongsha Island, ~200 nm west of Luzon Strait. To help determine the propagation speed and direction of NLIWs, Dr. Yang will deploy four additional moorings with bottom pressure sensors on the Dongsha continental slope.

WORK COMPLETED

In 2009, we attended two ONR workshops, then discussed and helped define the integrated observational program. We planned a pilot experiment for 2010 to conduct the performance test of the towed CTD chain and to practice the observation strategy for identifying generation sites and quantifying energy fluxes of internal tides and NLIWs within the Luzon Strait.

IMPACT/APPLICATION

Numerical models suggest strong internal tides are generated as barotropic tides interact with two prominent submarine ridges in Luzon Strait. These internal tides are believed the sources of nonlinear internal waves often observed in the South China Sea. The strength of internal tides is modulated by the barotropic tidal forcing, the strength of Kuroshio current, the background stratification and the strength of the Kuroshio front. It is important to quantify the barotropic to baroclinic tidal energy conversion, dissipation within the Luzon Strait, the energy fluxes toward South China Sea and Pacific Ocean, and the ultimate fate of the internal tidal energy.

RELATED PROJECTS

Energy Budget of Nonlinear Internal Waves near Dongsha (N00014-05-1-0284) as a part of NLIWI DRI. In this project, we study the dynamics and quantify the energy budget of nonlinear internal waves (NLIWs) in the South China Sea using observations taken from two intensive shipboard experiments in 2005 and 2007 and a set of nearly one year of velocity-profile measurements taken in 2006-2007 from three bottom mounted ADCPs across the continental slope east of Dongsha Plateau in the South China Sea. Results of NLIWI DRI will help improve our understanding of the dynamics of NLIWs and will apply to the present project.

Process Study of Oceanic Responses to Typhoons using Arrays of EM-APEX Floats and Moorings (N00014-08-1-0560) as a part of ITOP DRI. We will study the dynamics of the oceanic response to and recovery from tropical cyclones in the western Pacific using long-term mooring observations and an array of EM-APEX floats. Pacific typhoons may cause cold pools on the continental shelf of the East China Sea. The cold pool dynamics are likely related to the Kuroshio and its intrusion as well as the shelf/slope oceanic processes.